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and a bird must move forward to give the same apparent displacement of objects against the horizon. It is the purpose of the following note to derive an analytic expression for this curve.

Consider first the case of lateral vision. Let  $A$  be the starting point of the bird, and let the two objects,  $A_1$  and  $A_2$  in the original axis of vision be at the distances  $a_1$  and  $a_2$ , respectively, from  $A$ . Let  $y$  be the distance that the bird moves forward, and  $\alpha$  the angle that is subtended at its eye by the distance  $A_1A_2$ . (See Fig. 1.) Then

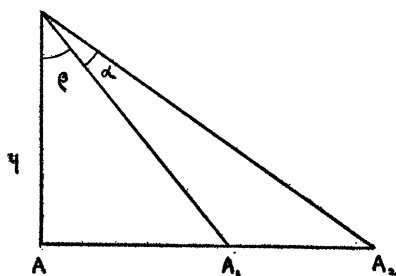


FIG. 1.

$$(1) \quad \tan(\alpha + \beta) = \frac{a_2}{y}, \quad \tan \beta = \frac{a_1}{y},$$

where  $\beta$  is defined in the figure. Using the trigonometric formula for the tangent of the sum of two angles, and replacing  $\tan \beta$  by its value from the second equation of (1), we get

$$(2) \quad \frac{y \tan \alpha + a_1}{y - a_1 \tan \alpha} = \frac{a_2}{y}.$$

Solving this for  $y$  gives

$$(3) \quad 2y \tan \alpha = a_2 - a_1 \pm \sqrt{(a_2 - a_1)^2 - 4a_1a_2 \tan^2 \alpha}.$$

In taking up the case of frontal vision, it is necessary, as Mr. Trowbridge states, to have a deflection between the line connecting the observed objects and the direction of the man's motion. Designating the angle of deflection by  $\delta$ , and the distance that the man moves from  $A$  by  $x$  (see Fig. 2), we have by the law of sines

$$(4) \quad \frac{x}{a_1} = \frac{\sin(\gamma + \delta)}{\sin \gamma} = \cos \delta + \cot \gamma \sin \delta,$$

where again  $AA_1 = a_1$ ,  $AA_2 = a_2$ , and  $\alpha$  is the angle subtended at the eye of the observer by  $AA_1$ . The angle  $\gamma$  is defined in the figure. Also

$$(5) \quad \frac{x}{a_2} = \frac{\sin(\alpha + \gamma + \delta)}{\sin(\alpha + \gamma)}.$$

By using the value of  $\cot \gamma$  obtained from (4), we can easily eliminate  $\gamma$  and reduce (5) to

$$(6) \quad \frac{x}{a_2} = \frac{x \sin(\alpha + \delta) - a_1 \sin \alpha}{x \sin \alpha - a_1 \sin(\alpha - \delta)}.$$

Solving for  $x$  gives

$$(7) \quad 2x \tan \alpha = a \pm \sqrt{a^2 - 4a_1a_2 \tan^2 \alpha},$$

where

$$a = (a_2 + a_1) \cos \delta \tan \alpha + (a_2 - a_1) \sin \delta.$$

Equations (3) and (7) then are parametric equations of the equal parallax curve.

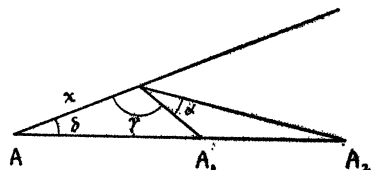


FIG. 2.

In plotting the curve of the practical problem we assign the values  $x=0$ ,  $y=0$  for  $\alpha=0$ . To a value of  $\alpha$  slightly greater than zero will correspond two values of  $x$  from (7) and two values of  $y$  from (3). It is easily seen that for the practical problem the smaller of these must be chosen in each case; that is, we must use the negative sign before the radicals in (3) and (7). For Mr. Trowbridge's curve the special values  $a_1=1,000$ ,  $a_2=2,000$  must be assigned, and in all instances  $\delta$  must of course be known.

PAUL R. RIDER

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#### A PREDECESSOR OF PRIESTLEY

TO THE EDITOR OF SCIENCE: The notice of the Priestley Memorial in the issue of SCIENCE for August 17, 1917, reminds me of the best chemical joke I have ever heard. I can hardly forgive the "new chemistry" for having spoiled it. At our Brown University club dinners in Philadelphia we never have any wine. Many years ago when water was "HO" the late Rev. Dr. H. Lincoln Wayland, the best wit I ever have known, after a very happy eulogy of water, ended his after-dinner speech

in the following manner: "Our chemists tell us, forsooth, that the composition of water was unknown until Priestley discovered oxygen in 1774. Never was there a greater mistake, for did not the prophet cry out, ages ago, 'HO! Everyone that thirsteth.'" W. W. KEEN

PHILADELPHIA, PA.,

August 20

### SCIENTIFIC BOOKS

*The Physical Basis of Society.* By CARL KELSEY, Professor of Sociology in the University of Pennsylvania. New York. D. Appleton & Co. 1916. Pp. xvi + 406.

As its name indicates, this book deals chiefly with the physical basis of human society. The following subjects are considered in sequence: the earth and man, mutual aid and the struggle for existence, the control of nature, the evolution of man, heredity, heredity and society, race differences, sex differences, the influences of society upon population, social institutions, and the nature of progress.

In the chapter on the earth and man, the author introduces too much detail for an elementary sociological work, especially on pages 1 to 28. Moreover, the real social significance of much of the material is not clearly shown. It would have been much better if the author had developed such a topic as the size and customs of the social group as influenced by the prevailing method of food getting, which is conditioned by physical environment.<sup>1</sup> Pages 28 and following give a fairly satisfactory summary of geographic influences.

In the chapter on mutual aid and the struggle for existence, the author again loses himself in a mass of ill-digested detail about the chemical and bacteriological aspects of plant life, and devotes to this subject space out of all proportion to its sociological significance.

The chapter on the control of nature is done more successfully, but the chapter on the evolution of man is very unsatisfactory. In

<sup>1</sup> See Ellen Semple's "Influence of Geographic Environment," pp. 54 to 65.

this latter chapter the author launches into a discussion of the old controversy about the evolution of man. He has reduced statements and quotations from authorities to such small compass that their real meaning and spirit are largely lost. At present, when students are generally open-minded in regard to the doctrine of evolution, it is a waste of time to revive this theological controversy in a book that is non-historical. The real subject-matter of this chapter, if the title is any indication of its aim, is treated in a few scant pages at the end.

The chapter on heredity is superior to any of the preceding and is a good treatment of the subject. The clarity of presentation might have been improved by better selection of diagrams. The chart on page 236 illustrating the inheritance of polydactylism, although taken from such a reliable source as Guyer, is not well selected to illustrate the inheritance of a dominant trait. An analysis of this chart reveals the fact that the transmission of polydactylism as a Mendelian trait in the family shown, is explicable only on the assumption that it is a recessive—and this contradicts the caption. But explanation of the chart in terms of the sex-limited hypothesis does, however, permit its interpretation in terms of dominance. Yet the author has not introduced this qualification, hence the example is not satisfactory. The remaining chapters are superior to the earlier ones.

In general, the book gives all appearances of having been too hastily written, and thus furnishes grounds for the criticism that the work of sociologists is superficial. This is all the more deplorable because the general plan and logic of arrangement of the book are excellent.

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*Recreations in Mathematics.* By H. E. LICKS. New York, D. Van Nostrand Co. 1917. Pp. v. + 155, \$1.25.

This is an amusing little book with various problems of more or less interest, particularly to the teacher of elementary mathematics. Unfortunately the historical notes are largely